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A Study on The Effect of Pedagogical and ICT Training in Teachers' Approaches to Online Teaching and Use of Digital Tools in Higher Education

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Abstract:

This study examines the relationship between teachers' pedagogical and ICT training, their approaches to online teaching, and the use of digital tools. The respondents for the study were sourced from various management institutions across the state of Karnataka. A total of 265 teachers were included in the present study. The data was collected in February 2024. The results showed that teachers used digital tools more for delivering information and less for activating students. The study revealed that pedagogical training enhanced teachers' learning-focused approach to online teaching and the diverse use of digital tools. Contrary to expectations, teachers' ICT training was not related to the use of digital tools. Therefore, it is important to provide pedagogical training to support teachers in implementing teaching in diverse teaching-learning environments and enhance building online teaching, in which digital tools are used to promote interaction in the online environment.

KEYWORDS
Pedagogical training, ICT training, Approaches to online teaching, Digital tools in teaching, Higher education

Introduction

The current higher education teaching-learning environment is complex and blended. Teachers need to be able to implement versatile pedagogical practices and incorporate digital tools, applications, and materials into their courses to support students in achieving the desired learning outcomes. COVID-19 has had a broad impact on teaching and learning activities at different levels during lockdown and after the pandemic (Kovacs et al., 2021; Maity et al., 2021; Oliveira et al., 2021; Yau et al., 2022), increasing not only the number of online courses but also new kinds of hybrid teaching courses in which students can attend face-to-face teaching on campus and also participate in synchronous or asynchronous online teaching. This has required teachers to be aware of learning technologies and digital tools and above all, know how to make meaningful use of them to support student learning. It has been suggested that teacher-student interaction in online teaching is even more important for student learning than in face-to-face teaching (Carter and Rukholm, 2008; Sun et al., 2022). Moreover, creating diverse interactive learning environments that support student learning requires pedagogical skills. Teachers with formal pedagogical training invest more in aligning the design and implementation of their teaching and consider the impact of teaching and assessment methods

on student learning (Postareff et al., 2007, 2008). There is evidence that pedagogical training may have an influence on teachers' views of teaching and enhance teachers' confidence as a teacher (Ödalen et al., 2019; Vilppu et al., 2019). While ICT training has been found to focus on familiarization with technologies, leaving behind pedagogical aspects (Røkenes and Krumsvik, 2014; Fernández-Batanero et al., 2022). Furthermore, teachers' approaches to teaching (i.e., whether teaching is seen as presenting factual knowledge and/or facilitating students' learning) reflect the use of teaching methods and the learning environment (Postareff and Lindblom-Ylänne, 2008). Previous studies have shown that Higher Education teachers' approaches to teaching vary in face-to-face contexts (e.g., Kember and Kwan, 2000; Postareff and Lindblom- Ylänne, 2008; Stes and Van Petegem, 2014), however, there is still little knowledge about how teachers' approaches to teaching vary in online teaching. Therefore, it is important to explore the role of pedagogical and ICT training in approaches to online teaching and the use of digital tools.

Pedagogical training and ICT training

Voluntary pedagogical training is provided for university teachers in many countries (Ödalen et al., 2019; Vilppu et al., 2019). The content and extent of pedagogical training can vary between universities; however, the aim is to support university students' learning and teachers' pedagogical skills (e.g., European Commission, 2013). The positive effect of pedagogical training on teachers' conceptions, teaching practices, reflective skills, and confidence has been shown in many studies (Ho et al., 2001; Postareff et al., 2007; Light and Calkins, 2008; Karm, 2010; Ödalen et al., 2019; Vilppu et al., 2019). However, some studies show no differences in teaching practices between teachers with pedagogical training and no training (Norton et al., 2005). In addition, there is contradictory evidence on the effects of pedagogical training of different lengths; some studies indicate that long periods of pedagogical training may be required (Gibbs and Coffey, 2004; Postareff et al., 2007) but a few studies show that even short training periods can have a positive influence on teachers' conceptions (Vilppu et al., 2019). In addition to pedagogical training, teachers must have an opportunity to be trained on the use of educational technology as the demand for online courses has grown, and adaptation for future society, e. g. working life requires equipping students with digital competence (Redecker and Punie, 2017; Kallunki et al., 2023). However, there is evidence teachers' technological training is insufficient and, it is problematic that the technological training usually lacks a pedagogical basis but focuses more on technological aspects (Fernández-Batanero et al., 2022; Kolil and Achuthan, 2022). Indeed, Gudmundsdottir and Hatlevik (2018) emphasizes the need to integrate ICT training into the pedagogical context but still doubt its transfer into actual teaching practices. Similarly, Røkenes and Krumsvik (2014) found that ICT training focused mostly on the organization and infrastructure of ICT training, rather than on how ICT could be implemented in learning practices. Moreover, Esteve-Mon et al. (2020) concluded that technological skills seem to be generally higher than pedagogical skills and that pedagogical training was crucial for adequate digital teaching competence of higher education teachers. Therefore, there is a need for integrative training in which pedagogical and technological aspects are integrated (Pongsakdi et al., 2021).

Building on Shulman's (1987) work on pedagogical content knowledge, Mishra and Koehler (2006) presented a Technological Pedagogical Content Knowledge (TPACK) framework that integrated digital technology knowledge with pedagogical content knowledge. The model is

widely applied in educational technology research is the TPACK that is used in diverse contexts (e.g., Almerich et al., 2016; Marcelo and Yot-Domíniguez, 2019; Esteve-Mon et al., 2020; Scherer et al., 2021; Ortega-Sánchez, 2023). The TPACK distinguishes three types of teacher knowledge: content, pedagogical, and technological knowledge (Mishra and Koehler, 2006). By integration of content, technology, and pedagogy it represents the different skills that a university teacher needs to teach in diverse teaching-teaching learning environments (Koehler et al., 2013). The more the three areas overlap, and the more aware teachers are of the complex interactions between them, the more effective teaching becomes when using digital tools (Koehler and Mishra, 2009). Thus, Mishra and Koehler (2006) have claimed that knowing how to use technology does not ensure that one knows how to utilize it in teaching.
Some recent studies applying the TPACK framework show that different forms of training in digital pedagogy can enhance teachers' skills and confidence in digital teaching (Brinkley-Etzkorn, 2018; Koh, 2020; Pongsakdi et al., 2021; Diamah et al., 2022). However, research examining how teachers' skills in terms of TPACK are related to their training is scarce and mainly carried out among pre-service and in-service teachers and focused on the academic degree (e.g., Luik et al., 2018; Diamah et al., 2022; Ibrohim et al., 2022; Long et al., 2022; Ortega-Sánchez, 2023). In the studies focusing on higher education teachers, it seems that either age (Cubeles and Riu, 2018) or academic degree (Castéra et al., 2020) are not linked to TPACK dimensions. Ortega-Sánchez (2023) also observed that among student teachers the scores of TPACK model's dimensions did not increase as their studies progressed. In particular, the relationship of voluntary pedagogical and ICT training to the TPACK model has not been studied much among higher education teachers.

Approaches to teaching in an online environment

Approaches to teaching refer to teaching intentions and strategies and reflect teachers' conceptions of teaching and learning (Trigwell et al., 1994). Studies have identified two approaches to teaching: a content-focused and a learning-focused approach. In a content-focused approach, the teacher focuses on content and sharing information. Students play a more or less passive role in their own learning (Kember and Kwan, 2000; Trigwell and Prosser, 2004; Postareff and Lindblom- Ylänne, 2008). Trigwell et al., 2005 also state that planning of teaching, management skills and the ability to use ICT are important aspects in content-focused teaching. In a learning-focused approach, teachers focus on students' learning and emphasize students' active role in the construction of their own knowledge by using a variety of active teaching methods and formative assessment to support student learning (Kember and Kwan, 2000; Trigwell et al., 2005; Postareff et al., 2007; Postareff and Lindblom-Ylänne, 2008). The content is also important in a learning-focused teaching, but in the content is taught by activating students, not just sharing information. It should be noted that these two approaches to teaching should not be viewed as contrasting conceptions of teaching, but rather as a continuum in which teachers can adopt both approaches in their teaching and combine them (Postareff and Lindblom-Ylänne, 2011; Stes and Van Petegem, 2014). There is evidence that teachers' approaches to teaching have evolved toward a more learning-focused approach after pedagogical training, in other words, their thinking about teaching and the strategies they implement in teaching have developed or changed (Trigwell et al., 1994; Ho et al., 2001; Postareff et al., 2007; Ginns et al., 2008; Vilppu et al., 2019). Approaches to teaching studies

have been mostly explored in physical teaching and learning environment (e.g., Prosser and Trigwell, 2006; Postareff and Lindblom-Ylänne, 2008).
In addition, it has been identified two approaches namely communication and collaboration-knowledge building which focus on helping students to develop their own understanding and knowledge as well as support their active role in their own learning (González, 2011, 2013), and thus closely like learning-focused approach (Trigwell et al., 1994). Interestingly, Nevgi et al. (2010) found that content- focused approach to use ICT in teaching was related to use of digital tools whereas no relationship was found between a learning-focused approach and the use digital tools. On the other hand, it has been considered that a learning-focused approach is necessary for the successful integration of ICT in teaching (Glassett and Schrum, 2009).

The use of digital tools in teaching

Educational technology can be used for several purposes in fostering learning, such as supporting collaborative learning and knowledge building (Häkkinen and Hämäläinen, 2012; Deng and Tavares, 2013), providing feedback to students and monitoring their learning progress (Jääskelä et al., 2017). It can also be part of implementing online exams and learning assessments (Myyry and Joutsenvirta, 2015; Marcelo and Yot-Domíniguez, 2019). In addition, educational technology can be used to enhance the design and use of student-centred learning environments that emphasize learners' active role in their own learning process and social interaction (Hannafin and Land, 1997; Ottenbreit- Leftwich et al., 2010; Reigeluth, 2014; Jensen et al., 2020).
Previous studies from different countries have shown that despite efforts to increase and improve digital teaching and learning in universities in different cultures, both teachers and students use of digital technology is rather limited (e.g., Bond et al., 2018; Amhag et al., 2019; Ferede et al., 2023; Söderlund et al., 2023). It is claimed that teachers' ICT training should take adequate time to learn and reflect upon new skills and knowledge, short-term training seems to be inefficient (Inamorato dos Santos et al., 2019). Research conducted during COVID-19 also shows that the pedagogical and didactic use of digital technologies to support students learning remains at a lower level among university teachers than in other aspects of use of ICT (e.g., Weidlich and Kalz, 2021; Sánchez-Caballé and Esteve-Mon, 2022). Further, it has been found that teachers have been replicating face-to-face lessons to online teaching environments and in doing so, the new pedagogical possibilities offered by ICT have possibly been lost (Casado-Aranda et al., 2021; Usher et al., 2021). To understand these discrepancies, it is important to examine how concepts related to teaching and learning, such as approaches to online teaching are related to the use of digital technologies in teaching. Teachers' pedagogical training, approaches to online teaching and the use of digital tools have been studied separately (e.g., Postareff and Lindblom-Ylänne, 2008; González, 2013; Bond et al., 2018; Scherer et al., 2021). Furthermore, as there is contradictory evidence of pedagogical and ICT training and only little research of approaches to online teaching, it is important to explore how the extent of pedagogical training is related to teachers' approaches to online teaching and the use of digital tools.

Objectives of the study

To explore the relationship between pedagogical and ICT training in Higher Education teachers and their approaches to online teaching and the use of digital tools.

Scope of the study

In our study, we examine teachers' digital teaching at post-graduate institutions across the state of Karnataka. Between 2019 and 2021, online learning was seen as one of the strategic goals of Many higher education Centres.

Respondent's Profile

A total of 273 faculty members teaching at postgraduate institutions across the state of Karnataka responded to the online survey. Eight of the respondents did not consent to the use of their answers in the study so the final sample size was 265. Of the participants, 137 (52%) were female, and 128 were males (48%), More than one-third of the respondents had more than 20 years of teaching experience (34%, n = 89); 29% had 11–20 years, 29% had 4–10 years and 8% had 3 years or less of teaching experience. Most of the teachers had pedagogical training. Most of the teachers (48%, n = 126) had participated in ICT training one to three times, 20% (n = 53) more than three times and 32% (n = 84) had not participated in ICT training.

Design and procedure

The research design was cross-sectional (Matthews and Ross, 2010). A Google form-based questionnaire was shared with the target respondents. The Participation was voluntary and no compensation was provided. The questionnaire consisted of questions about how and for what purposes the participants had used digital tools in teaching their beliefs about the use of digital tools in teaching and questions about their participation in pedagogical and ICT training and demographic questions.

Measures

Pedagogical training and ICT training were measured by asking the respondents about participation in pedagogical and ICT training.
Approaches to online teaching were measured by a modified version of the Approaches to Online Teaching scale by Nevgi et al. (2010), which originally was adopted from the Approaches to Teaching Inventory (ATI) (Trigwell and Prosser, 2004). There were six items measured on a five-point scale (1 = fully disagree; 5 = fully agree). Three items measured a content-focused approach (alpha 0.77): ("I use digital technologies to deliver information and materials to students."); finally, three items measured a learning-focused approach (alpha 0.82): ("I use digital technologies in order to encourage my students to discuss the topic").
Use of digital tools for teaching were enquired by nine items measuring how and for what purpose the participants had used digital tools in teaching. This part of the survey was developed on the basis of previous studies (Häkkinen and Hämäläinen, 2012; Deng and Tavares, 2013; Myyry and Joutsenvirta, 2015) and has been used and validated in our prior study (Myyry et al., 2022). Participants were asked to rate statements on a five-point Likert-scale (1 =never; 5 =all the time). The items consisted of three factors: using digital tools for

sharing/delivering information "I inform students about the course/studying" (three items, alpha= 0.81); using digital tools for activating students "My students produce collaborative learning outcomes" (four items, alpha= 0.62); and using digital tools for assessment or following progress "I give feedback and assess students' assignments or use for peer feedback and assessment" (two items, alpha= 0.77) (Myyry et al., 2022).

Data analysis

First, we conducted exploratory factor analysis (principal axis factoring with varimax rotation) for the items of approaches to online teaching. Explorative analysis of the items measuring approaches to online teaching indicated that a two-factor solution was the clearest: content-focused and learning-focused approach. Factor loadings and Cronbach's alphas are presented in Table 1.

Approaches to Teaching in online Context scales	Factor loading
Content-focused approach, *a* = 0.69	
I use technology in my teaching so that students have access to all relevant information.	0.769
I think that an important reason for using technology in teaching is to share good materials to students.	0.734
I use digital technologies to deliver information and materials to students.	0.584
Learning-focused approach *a* = 0.69	
I use digital technologies to encourage my students to discuss the topic.	0.807
I prefer to use technology in my teaching so that students have the opportunity to present their own ideas.	0.769
I help students develop their own understanding of the topic they are studying.	0.642

TABLE 1 Factor loadings of the items measuring approaches to teaching

The relationships between approaches to online teaching and the use of digital tools were analyzed by Pearson's correlations. The relations between pedagogical and ICT training and approaches to online teaching, and the use of digital tools were analyzed by using One-Way ANOVA with Bonferroni's posthoc test. The effect sizes were calculated using eta-squared values. Statistical analyses were conducted using SPSS 25.

Results

Before the main analyses, descriptive statistics and correlations were explored. The results showed that teachers used digital tools mostly for information delivery and assessment. Respondents received the lowest scores for student activation, the highest scores for the

content-focused approach and relatively high scores for the learning-focused approach. Table 2 shows the means and standard deviations of approaches to online teaching and the use of digital tools.

Pearson's correlations showed that approaches to online teaching correlated to the use of digital tools (Table 3). More precisely, the content-focused approach had the highest correlation with information delivery, whereas the learning-focused approach correlated with student activation.

Main aim was to explore how the extent of pedagogical training and ICT training are related to teachers' approaches to online teaching (Table 4). The results showed that the pedagogical training was related to the learning-focused approach. Bonferroni's post hoc test revealed that teachers who had more than 25 study credits of pedagogical training received statistically significantly higher scores on the learning-focused approach than teachers without pedagogical training. Similarly, ICT training was related to a learning-focused approach. Teachers who had participated in ICT training more than three times had higher scores on the learning- focused approach than teachers who had not participated in ICT training. The results showed that pedagogical training had statistically significant relations to the use of digital tools (Table 5). In assessment, there were no differences between the teachers with different amounts of pedagogical training. The results also revealed that ICT training was not related to the use of digital tools.

	Mean	**Standard deviation**
Use of digital tools		
Information delivery	3.45	0.83
Student activation	1.74	0.98
Assessment	2.15	1.27
Approaches to online teaching		
Content-focused approach	4.19	0.69
Learning-focused approach	3.53	0.85

TABLE 2 Means and standard deviations of use of digital tools and approaches to teaching

	1	**2**	**3**	**4**	**5**
Information delivery	1				
Student activation	0.473	1			
Assessment	0.459	0.449	1		
Content-focused approach	0.411	0.227	0.277	1	

Learning- focused approach	0.358	0.485	0.349	0.512	1

**All the correlations are significant at the 0.001 level.

TABLE 3- Pearson's correlations among the use of digital tools and approaches to online teaching.

Pedagogical and ICT training	**Content-focused approach**		**Learning-focused approach**	
	Mean	**SD**	**Mean**	**SD**
Pedagogical training				
No pedagogical training (n = 50)	4.07	0.71	3.23	0.88
1–10 cr (n = 58)	4.30	0.56	3.62	0.64
11–25 cr (n = 69)	4.26	0.60	3.56	0.73
more than 25 cr (n = 87)	4.14	0.82	3.65	0.99
F $\eta 2$	1.33 0.015	$p > 0.05$	3.00 0.034	$p < 0.05$
ICT training				
No ICT training (n = 84)	4.07	0.85	3.34	0.90
1–3 training sessions (n = 126)	4.28	0.58	3.62	0.79
more than three training sessions (n = 53)	4.18	0.67	3.69	0.85
F $\eta 2$	2.20 0.017	$P > 0.05$	3.93 0.029	$p < 0.05$

TABLE 4 - Means and standard deviations of approaches to online teaching about pedagogical and ICT training

Use of digital tools	**Information delivery**		**Student Activation**		**Assessment**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Pedagogical training						
No pedagogical training (n = 50)	3.11	1.11	1.49	0.95	1.99	1.26
1–10 cr (n = 58)	3.52	0.64	1.56	0.89	1.94	1.23
11–25 cr (n = 69)	3.46	0.74	1.82	1.00	2.16	1.31
more than 25 cr (n = 87)	3.58	0.74	1.95	0.99	2.40	1.23
F $\eta 2$	3.82 0.042	$p < 0.05$	3.40 0.038	$p < 0.05$	1.95 0.022	$p > 0.05$
ICT training						

No ICT training (n = 84)	3.31	1.01	1.64	0.97	2.18	1.23
1–3 training sessions (n = 126)	3.49	0.71	1.79	1.01	2.06	1.35
more than three training sessions (n = 53)	3.56	0.77	1.80	0.91	2.33	1.07
F $\eta 2$	1.89 0.014	$p > 0.05$	0.71 0.005	$p > 0.05$	0.88 0.007	$p > 0.05$

TABLE 5 -The relationships between the use of digital tools and pedagogical training and ICT training.

Findings of the study

- The present study provides new insights into teachers' pedagogical and ICT training in online teaching in higher education. In addition, it enhances knowledge about the approaches to online teaching and how teachers use digital tools in their teaching.
- The study showed that pedagogical and ICT training enhanced teachers' ability to apply a learning-focused approach in an online environment.
- The learning-focused approach is necessary for the successful integration of ICT in teaching (Glassett and Schrum, 2009). Previous studies have shown that a relatively large amount of pedagogical training (more than 25 ECTS) is needed to influence approaches to teaching (Gibbs and Coffey, 2004; Postareff et al., 2007). This was confirmed in our study in the online context.
- The present study also showed that teachers with an extensive amount of pedagogical training used digital tools significantly more for student activation as well as information delivery than teachers without pedagogical training. Furthermore, the results of the present study indicate that the learning-focused approach was a determinant factor for a more diverse and interactive use of digital tools which is contradictory to a previous study (Nevgi et al., 2010).
- The surprising finding of our study was that teachers' ICT training was not related to the use of digital tools, although ICT training could be expected to support the use of digital tools and the development of digital skills as studies applying the TPACK framework suggest (Brinkley-Etzkorn, 2018; Koh, 2020; Pongsakdi et al., 2021; Diamah et al., 2022).
- It may be that in ICT training the pedagogical content is more superficial and the training is shorter, above all, focusing on familiarization with technology, including student activation tools and technical skills. This short and formal ICT training can explain why teachers in our study used digital tools mostly for information delivery and assessment, rather than to activate students through collaborative learning tasks and discussions.
- The results of the present study suggest that in pedagogical training teachers enhance not only their understanding of the importance of students' active role, but they also

learn to apply diverse pedagogical practices and use digital tools in multiple ways to support student learning. Our study also confirms Mishra and Koehler's (2006) claim that integration of pedagogical and technological knowledge is essential for effective teaching.

Conclusion

In summary, the present study showed that pedagogical training plays a key role in how teachers approach their teaching and use digital tools in an online environment. It seems that pedagogical training helps teachers cope with the changes in the learning environment and organize learning-focused teaching also in an online context, which has become one of the key learning environments. During the post-pandemic time, Higher Education institutions struggled to adapt to new ways of teaching, based on the lessons learned from the Covid-19 lockdown. Blended or hybrid remote teaching, as well as pure online courses such as MOOCs, are claimed to be more typical in the future (Guppy et al., 2022), which increases the need for pedagogical and ICT teacher training. The challenge today is to integrate pedagogical and technological training so that both pedagogical and technological aspects of teaching in theory and practice are better addressed.

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